Synopsis of Ph.D Thesis

STUDIES ON PHYSICO-CHEMICAL CHARACTERISTICS, PLANKTON DIVERSITY AND ICHTHYOFAUNA OF IDUKKI RESERVOIR, KERALA, INDIA.

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Reservoirs have social and economic importance for human societies, as they bring industrial, agricultural and urban development, contributing with electric power and supplying water for human consumption and irrigation (Tundisi, 2003). A pre-impoundment survey of the fauna and flora of any water body is necessary because it provides a checklist of organisms present in the water for subsequent exploitation, conservation and sustainable management of the resources. The maintenance of a healthy aquatic ecosystem is highly depend on the physico-chemical properties of water and the biological diversity. The physico-chemical means are useful in detecting the effects of pollution on the water quality but changes in the trophic conditions of water are reflected in the biotic community structure including species pattern, distribution and diversity (Kaushik and Saxena, 1995). Water quality plays a big role in plankton productivity as well as the biology of the cultured organisms and final yields (Dhawan and Karu, 2002). The fish fauna of a reservoir basically represents the fish diversity and their abundance.

As Kerala is blessed with 30 reservoirs, the investigations undertaken to assess the water quality of reservoirs were only few ones. A review of literature reveals that not such studies were conducted in Idukki reservoir except Khatri in 1985. Therefore, the present study is conducted to assess the seasonal and spatial variations in some important physico-chemical parameters, diversity and density of phytoplankton and zooplankton and fish fauna of Idukki reservoir to evaluate the present status of reservoir.

The results of the present study are organized under 7 chapters. In the first introductory chapter, the rationale of the study and the present scenario in our reservoirs are highlighted. The need and importance of the study on reservoirs are also discussed in this chapter. An exhaustive review on similar studies conducted both nationally as well as internationally is also reviewed.

In chapter 2, the materials and methods employed for the present study are described. The study area is Idukki reservoir, the biggest man-made hydro-electric project in Kerala and when it full will have a water spread area of 23.1 sq. miles (59.83 sq.km) and this storage regulates the yield of over 250.7 sq.miles (1649.3 sq.km). Idukki reservoir encompasses 3 dams - Idukki arch dam across Periyar, the largest river in Kerala at Idukki gorge; Cheruthoni straight concrete gravity dam across the tributary river Cheruthoni and Kulamavu dam across Kilivallithodu. 16 stations were selected for sampling and samples for physico-chemical analysis and plankton were collected from the water surface bimonthly for a period of 3 years. 28 physico-chemical parameters were analysed using standard methods. For the study of ichthyofauna diversity, fishes were sampled bimonthly from all the 16 stations with the help of fishermen using gillnet. The systematic identification of the plankton and fishes up to the level of species was done adopting the standard methods and keys. The variations of each particular parameter across stations and that over seasons were calculated using the ANOVA. The correlation (Pearson correlation coefficient) and level of dependence between the physico-chemical parameters, total phytoplankton, phytoplankton classes, total zooplankton and zooplankton groups with the physico-chemical factors were analysed. The species diversity indices, viz., Shannon – Weiner diversity index (H^1), Margalef index, species richness index and evenness index (D) were computed for plankton and fish.

The physico-chemical characteristics of the reservoir are presented in chapter 3. This chapter starts with an introduction, followed by results with corresponding tables, figures and discussion. Significant seasonal and spatial variations were observed in the case of atmospheric temperature, water temperature, turbidity, electrical conductivity (EC), transparency, pH, chloride, calcium,

magnesium, nitrate and sulphate where as the parameters such as dissolved oxygen (DO), free carbondioxide (free $CO_{2)}$, total hardness, total alkalinity, total dissolved solids (TDS), chemical oxygen demand (COD), biological oxygen demand (BOD), sodium, potassium, phosphate and iron were not showed much spatial variations in the reservoir. COD and BOD were not showed seasonal variation too. The mercury, cadmium, zinc and copper were found below traceable level. H_2S was also not

obtained in the reservoir during the period of study. Season wise analysis showed that the average of rainfall in the watershed of Idukki reservoir was found higher in the monsoon season (652.87mm) followed by postmonsoon (125.43mm) and it was very low in premonsoon period (83.21mm). The mean seasonal variation of all the physico-chemical parameters except turbidity, DO, nitrate, phosphate, sulphate and iron were showed highest values during premonsoon season, lowest during monsoon season and moderate during postmonsoon season. The parameters such as turbidity, DO and nitrate were recorded high in monsoon season, low in premonsoon and moderate in postmonsoon. The highest phosphate content was noticed in postmonsoon season and low in premonsoon while it was not recorded in monsoon season. Sulphate was recorded only in premonsoon season where as iron was observed in premonsoon and postmonsoon.

The chapter 4 embodies the phytoplankton of Idukki reservoir. Their diversity, density and seasonal variation were analysed. This chapter includes an introduction, results (with tables and figures) and discussion. Five classes of phytoplankton namely, Chlorophyceae (Green algae), Bacillariophyceae (Diatoms), Cyanophyceae (Blue-green algae), Dinophyceae and Desmidiaceae (Desmids) were recorded in the reservoir. 37 species, belonging to 31 genera were found in the phytoplankton classes. A total phytoplankton number of 1627.37/l was recorded in the reservoir. Chlorophyceae dominated the phytoplankton classes in terms of number/litre constituting 36.26% of the total phytoplankton. The next dominant class was Bacillariophyceae (30.05%) followed by Desmidiaceae (19.79%), Cyanophyceae (10.15%) and Dinophyceae (3.74%). Among phytoplankton

species, *Ankistrodesmus falcatus* was found to be most abundant in the reservoir. The average of 3 year study showed that phytoplankton was abundant in the premonsoon season followed by postmonsoon season and monsoon season. All sampling stations in the reservoir showed similar species composition but marked the variations in the occurrence and density among stations.

Chapter 5 deals with the zooplankton in Idukki reservoir and illustrates their diversity and density in 3 seasons. This chapter includes introduction, result with tables and figures and discussion. Four different groups, such as Rotifera, Copepoda, Cladocera and Ostracoda were represented the zooplankton community in Idukki reservoir. 18 species (15 genera) of zooplankton including *Nauplii* were identified, of which 7 species (5 genera) belongs to Rotifera, 5 species (5 genera) and *Nauplii* belongs to Copepoda, 5 species (4 genera) belongs to Cladocera and 1 (1 genera) belongs to Ostracoda.

A total zooplankton number of 319.68/l was recorded in the reservoir where the Copepoda constituted the largest group in terms of organisms/l making the average percentage composition of 35.80% in total zooplankton population. It was followed by Rotifera (35%), Cladocera (26.23%) and Ostracoda (2.97%). All stations showed similar species composition with noticeable difference in their occurrence and abundance among stations. Among zooplankton, *Nauplius* larva was the most abundant constituting 16.11% of the total zooplankton in the reservoir. Zooplankton were most abundant during premonsoon season while least abundant during monsoon season and moderate during postmonsoon season.

The icthyofauna, their diversity and seasonal abundance are summarized in chapter 6. This chapter also contains introduction, result (tables and figures included) and discussion. In the present study, total 19 species of fish belonging to 18 genera, 11 families and 6 orders were recorded in the reservoir. The family Cyprinidae was found to be the most diverse, represented by 9 species and the remaining families were represented by a single species each. Species belong to family Cyprinidae

were found more abundant (43.91%) followed by Siluridae (18.40%), Channidae (7.78%), Cichlidae (7.36%), Bagridae (5.30%), Mastacembelidae (4.95%), Cyprinodontidae (4.66%), Cobitidae (3.95%), Ambassidae (3.41%), Claridae (0.12%), and Heteropneustidae (0.11%). The fish recorded from the Idukki reservoir were *Apocheilus lineatus, Barilius bakeri, Catla catla, Channa gachua, Cirrhinus cirrhosa, Clarias batrachus, Cyprinus carpio, Heteropneustis fossilis, Labeo rohita, Mastacembelus guentheri, Mystus vittatus, Nemacheilus rupecola, Ompok bimaculatus, Oreochromis mossambicus, Parambassis dayi, Puntius melanampyx, Puntius vittatus, Rasbora daniconius* and *Tor khudree.* The average of fish abundance obtained in the reservoir showed that the species *Ompok bimaculatus* recorded the highest catch by the number and it predominated as per relative abundance also. Channa Gachua recorded the highest total biomass and relative biomass in the reservoir.

Premonsoon season recorded the highest abundance of fish by the number followed by postmonsoon and monsoon. *Ompok bimaculatus* was found to be the most dominant during premonsoon and monsoon season whereas in postmonsoon Cirrhinus cirrhosa was the most abundant species. While comparing the relative abundance in different seasons, during pre monsoon and monsoon seasons *Ompok bimaculatus* recorded the highest values of 26.08% and 14.43% respectively. But in postmonsoon season *Cirrhinus cirrhosa* recorded the highest abundance of 20.36%. Monsoon season recorded the highest biomass whereas premonsoon and postmonsoon seasons showed equality in the biomass obtained.

Chapter 6 analyses the summary and recommendations. Summary highlights the important results of the study. Based on the results of the study some recommendations were also framed and presented. During the present investigation, it is clear that the main challenges in enhancing fish production in Idukki reservoir is attributed to the undesirable species mix, lack of scientific database, inadequate stocking, wrong selection of species and multiple ownership. Reservoirs like Idukki which was built only for power generation and irrigation can be turned to an important fish production centres. Fishing rights in Idukki reservoir is given only to the tribal community living nearby the

reservoir. Besides being contributed to the yield enhancement, fishery development programmes in this reservoir would help to develop the livelihood of this people. The quality of water free from any sort of pollution in Idukki reservoir also provides a favourable niche for fish production. The fish production in Idukki reservoir clearly indicates that by proper and efficient management, this reservoir can be turned as an extremely productive one and it can produce enviable spectrum of fish genetic resources which can lead to a many fold increase in inland fish production in the state.

This chapter is followed by a list of literature consulted and cited, under the heading 'References'.